DESIGN MEMORANDUM

ON

PORTLAND HARBOR, MAINE

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

WALTHAM 54, MASSACHUSETTS

July 1963

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

18 July 1963

SUBJECT: Design Memorandum for Portland Harbor, Maine
(45-foot project)

TO: Chief of Engineers
ATTENTION: ENGCW-E
Washington 25, D. C.

1. In accordance with EM 1110-2-1150, Engineering and Design, Definite Project Studies, dated 15 January 1962, there are inclosed four (4) copies of the design memorandum on the subject project. The work to be undertaken involves dredging operation with no special design or excavation problems. The design memorandum is approved in accordance with paragraph 6(b) of the above referenced authority.

2. Planning on this project is about 98% complete. Formal assurances of local cooperation have been executed.

1 Incl
Design Memo (in quad)

P. C. HYZER
Brigadier General, USA
Division Engineer

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 Trapelo Road
Waltham, Massachusetts

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DESIGN MEMORANDUM ON PORTLAND HARBOR, MAINE

PERTINENT DATA

1. A summary of the physical features and costs of the existing project for Portland Harbor, Maine is as follows:

Features	Present Estimate (1963)
Completed project modifications	$ 4,406,000
Uncompleted project modifications Dredging and rock removal in the Main Entrance Channel and House Island Anchorage to a depth of 45 feet	8,135,000*
Total Project Cost	$12,541,000

*Includes $35,000 preauthorization study costs.

PROJECT AUTHORIZATION

2. Authorization. The uncompleted modification for the improvement of Portland Harbor was authorized by the River and Harbor Act of 23 October 1962. The project, as authorized, modifies the existing project to provide for an entrance channel 1,000 feet wide and 45 feet deep from deep water in Casco Bay to a line opposite Fort Gorges, and a maneuvering basin and anchorage 45 feet deep in the existing House Island anchorage area; all generally in accordance with the plan of the Division Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable.

3. The project modification was authorized subject to the requirements that, prior to construction, local interests agree to:

a. Hold and save the United States free from damages due to the construction and maintenance of the improvements, and

b. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and necessary retaining dikes, bulkheads, and embankments therefor or the costs of such retaining works.

4. The existing project for Portland Harbor was adopted 4 July 1836, and supplemented both by enactments from 1866 to 1946, and Harbor line revisions of 28 June 1920. It provides for an anchorage area 35 feet deep, approximately 170 acres in area northwest of House Island; an anchorage area 30 feet deep off the eastern end of the city; a channel 35 feet deep of varying width from the sea to Portland Bridge, thence 400 feet wide in Fore River to the former site of the Vaughan Bridge thence 300 feet wide to the Boston and Maine Railroad Bridge; a turning basin 35 feet deep easterly of the site of the former Vaughan Bridge; a channel 300 feet wide 30 feet deep from the 30-foot anchorage toward Back Cove to the Grand Trunk Railroad Bridge; a channel 14 feet deep between the Grand Trunk Railroad Bridge and the former Tukey Bridge; a channel 12 feet deep and 300 feet wide from Tukey Bridge 2,500 feet upstream; the removal of two obstructing ledges in the main ship channel to a depth of 40 feet; a stone breakwater about 2,000 feet long on the southerly side of the mouth of the inner harbor; a stone breakwater about 900 feet long from Spring Point to Spring Point Light; and the maintenance of Soldier Ledge channel in Hussey Sound to a depth of 40 feet. The existing project was completed in 1958. Total expenditures for the project amount to $4,406,000. The improvement considered in this design memorandum is the work authorized by the River and Harbor Act of 1962, as described in paragraph 2. Advance planning only on the uncompleted modification has been done. The existing project is shown on the attached project plan.

5. The provisions of the River and Harbor Act of 8 August 1917, as set forth in House Document No. 71, Sixty Fifth Congress required assurance that adequate terminal facilities with berthing depth of 35 feet be provided for deep draft vessels. At a cost of $1,750,000 the State of Maine constructed a pier 1,000 feet long and 328 feet wide with a depth of 35 feet along the easterly side. Construction of this pier is the only measure of local cooperation thus far required for Portland Harbor.

INVESTIGATIONS

6. Physical investigations carried out in support of the survey report contained in House Document No. 216, 87th Congress, 1st Session, were as follows:

a. Hydrographic, topographic and probing surveys were made in 1959.

b. Subsequent to project authorization, probing and boring surveys were accomplished in March 1963 by contract. Detailed probings were made on 25-foot spacing over known rock areas in the main ship channel as located from surveys prior to 1959 and previously removed under a project feature of lesser depth. Detailed probings to a depth of 47 feet or refusal were made on 100-foot spacing on the shoal area crossing the main ship channel to determine the presence of rock. Refusals encountered within the shoal area were developed on 25-foot spacing to determine the extent of the rock within project depth limits.

Probings in the House Island Anchorage made from previous surveys were used and were supplemented by additional probes by contract in March 1963 taken along the limits and within the anchorage area. The extent of probings required and accomplished was based on a geological reconnaisance survey. A total of 18 core borings was made in the probed areas.

LOCAL COOPERATION

7. The requirements of local cooperation as required by the authorizing document are stated in paragraph 3 above. The Governor of the State, the City of Portland and the City of South Portland have each executed the necessary assurances that the requirements of local cooperation will be met. Investigation of the nature of the materials to be dredged and the relative location of adequate spoil areas indicated the impracticability of dredging by the hydraulic process, consequently spoil areas were not requested or furnished. The views and concurrence with the project plan by the Governor of the State of Maine, the Maine Port Authority and shipping interests including the American Merchant Marine Institute, were obtained during the survey study. The project plan has been reviewed with these interests in various conferences during the construction planning phase. The names of the principal officers and representatives contacted during the preconstruction planning phase are listed below:

Governor John H. Reed, State House, Augusta, Maine
Mr. Edward Langlois, General Manager, Maine Port Authority, Portland, Maine
Mr. Graham Watt, City Manager, Portland, Maine
Mr. Barnet Shur, Corporation Counsel, Portland, Me.
Mr. Bernal B. Allen, City Manager, South Portland, Me.
Mr. Seymour Nathanson, Corporation Counsel, South Portland, Me.
Mr. Carl Emerson, President, Portland Pipe Line Company, Portland, Maine

LOCATION AND TRIBUTARY AREA

8. Portland Harbor is at the southwest end of Casco Bay on the Maine coast, 100 miles northeast of Boston, Massachusetts. The main ship channel extends northward from the ocean between Cushing Island on the east and the mainland on the west to the outer and inner harbor sections. The inner harbor extends westward up the Fore River between Portland on the north and South Portland. Back Cove, about 1 mile in diameter, is a small harbor extension to the north. There are two authorized anchorages for deep-draft vessels in Portland Harbor and an additional anchorage is available in Hussey Sound, about 5 miles northeast of Portland. The inner harbor and anchorages are well protected against storms. The mean range of tide in Portland Harbor is 8.9 feet.

9. The immediate tributary area consists of the cities of Portland and South Portland, both of which border the harbor. However, since the harbor is the receiving port for the contiguous area, it is considered that the areas comprising all of southern Maine and the adjacent area of New Hampshire are included in the tributary area.

10. The City of Portland is the largest city in Maine. It is chiefly an industrial city, manufacturing many diversified products. South Portland is primarily residential, although the major oil terminals and tank farms serving the locality are situated within its limits.

11. South Portland is the terminus of 2 petroleum pipelines which connect to 6 refineries in East Montreal, Canada. About 12,000,000 tons of crude oil are transmitted through these lines annually. In this respect that area of eastern Canada served by these 6 Montreal refineries must be considered tributary to the Port of Portland.

PROJECT PLAN

12. The project plan includes the removal and disposal of ledge rock and ordinary materials from the main ship channel, in the entrance to Portland Harbor, and the existing anchorage area and maneuvering area immediately northwest of House Island to provide for a clear depth of 45 feet below mean low water and a channel width of 1,000 feet, as shown on the attached map. The present plan is the same as that recommended in House Document Number 216, 87th Congress, 1st Session, and authorized by the River and Harbor Act of 1962, and is considered to be the most feasible and economic p lan to provide for efficient use of the harbor by present and prospective deep-draft tanker traffic.

13. In order to provide a clear channel to a depth of 45 feet, 1,000 feet wide, from deep water in Casco Bay to a line about opposite Fort Gorges, the project plan involves the drilling, blasting and removal of about 35,000 cubic yards of ledge rock and 39,000 cubic yards of overlying materials to a required depth of 46 feet, plus 2 feet of allowable overdepth, and about 130,000 cubic yards of rather coarse and heavy materials to a depth of 45 feet, plus 2 feet of allowable overdepth. The required 46-foot depth in rock areas is in accordance with standard design criteria for removal of underlying rock to enable future project maintenance of the project to a clear depth of 45 feet.

The two-foot allowable overdepth provides for inaccuracies in dredging process at the specified depth and insures attainment of project depth. In addition the project plan involves the removal and disposal of about 3,860,000 cubic yards of ordinary material to deepen the existing 35-foot maneuvering basin and anchorage near House Island to a depth of 45 feet, plus an allowable overdepth of 2 feet. Removal of all materials will be accomplished by means of a bucket dredge with disposal in an approved dumping area at sea.

DEPARTURES FROM PROJECT DOCUMENT PLAN

14. The present project plan is the same as that recommended in the authorizing document and authorized by Congress. With the expception of refinement of project cost estimates based on more detailed field investigation completed during the planning phase, changes in the document project plan are not anticipated. Overdepth allowance presently contemplated are the same as those used in the authorizing document.

COST ESTIMATES

15. The estimate of project cost determined in the authorizing document was based on random probings and a hydrograpic survey made in 1959 during the study phase and indicated that the materials to be removed consisted of mud, gravel, clay, and ledge rock. It was estimated that 4,027,000 cubic yards of ordinary material and 21,000 cubic yards of ledge rock would be required to be removed from within project limits. Quantities are in terms of in-place measurement and include an allowance of 2 feet of overdepth, side slopes of 1 on 1 in rock areas and 1 on 3 in ordinary material. It was anticipated that dredging would be accomplished by bucket dredge with disposal of waste materials at sea. The current estimate of cost is based on quantities determined by detailed probing and boring surveys made in March 1963 and include an allowance of two feet of overdepth dredging to provide for inaccuracies in the dredging process. The cost is based on bucket dredge disposal at sea and prices prevailing in June 1963.

16. Current Estimate of Costs (June 1963):

Contract			
Entrance Channel			
Rock Removal	- 35,000 c.y @ $35/c.y	- $1,225,000	
Overburden	- 39,000 c.y @ $ 5/c.y	- 195,000	
Ordinary Materials	- 130,000 c.y @ $1.50/c.y	- 195,000	
		1,615,000	
Contingencies		160,000	
	Total		$1,775,000
Anchorage and Maneuvering area			
Ordinary materials	- 3,860,000 c.y @ $1.35	5,211,000	
Contingencies		524,000	
	Total		5,735,000
Total Contract Costs			7,510,000
Pre-authorization studies	35,000		
Engineering and Design	125,000		
Supervision and Administration	465,000		
	Total		625,000
Total Project Construction Cost			8,135,000
Aids to Navigation (Coast Guard)			28,000
Total Project Costs (Federal)			$8,163,000

17. Comparison of Costs:

	Document Estimate (Sept. 1960)	Latest Approved Estimate 1 July 1962	Current Estimate June 1963
Volume:			
Entrance Channel			
Dredging	200,000 cy	200,000 cy	169,000 cy
Rock	21,000 cy	21,000 cy	35,000 cy
Anchorage and maneuvering area			
Dredging	3,827,000 cy	3,827,000 cy	3,860,000 cy
Contract:			
Entrance Channel			
Dredging	$ 300,000	$ 265,000	$ 390,000
Rock	819,000	840,000	1,225,000
Anchorage and maneuvering area			
Dredging	5,742,000	5,135,000	5,211,000
Contingencies	1,029,000	935,000	684,000
Total Contract	$7,890,000	$7,175,000	$7,510,000
Pre-Authorization Studies	35,000	35,000	35,000
Engineering and Design	50,000	70,000	125,000
Supervision and Administration	400,000	355,000	465,000
Total Construction Cost (Fed)	8,375,000	7,635,000	8,135,000
Aids to Navigation (U.S. Coast Guard)	28,000	28,000	28,000
Total Project Cost (Fed)	$8,403,000	$7,663,000	$8,163,000

18a. The significant increase in cost of rock removal is based on increased quantities as determined from detailed probing and boring survey made during preconstruction planning.

b. The increase in cost of removal of dredged materials in the entrance channel is predicated on a firmer separation of cost of overburden removal which would be accomplished in connection with rock removal and the cost for ordinary dredging. Previous estimate included a single unit price for all dredged materials including overburden on rock.

c. The increase in Engineering and Design is based on accomplishment of probing and boring survey by contract; actual costs incurred; and detailed development of rock areas found during the field investigation.

d. The increase in Supervision and Administration reflects costs due to increase in contract amount and re-estimate of government costs based on present schedule of construction.

SCHEDULE FOR DESIGN AND CONSTRUCTION

19. The improvement of Portland Harbor can be considered in two segments, i.e., the entrance channel and the anchorage and maneuvering basin. Since provision of project depth in the entrance channel is of greater urgency and since the work involved is primarily the removal and disposal of ledge rock which would require plant especially equipped for this type of work, it is proposed to contract for work in the entrance channel under an initial contract. Dredging of the anchorage and maneuvering area involving the removal and disposal of ordinary materials is proposed to be accomplished under a second contract.

20. Improvement of the entrance channel involves the drilling, blasting, removal and disposal of about 35,000 cubic yards of rock and 169,000 cubic yards of ordinary material overlying and adjacent to the rock areas. Time required for completion of work under the initial contract is 7 months. Plans and specifications for the second contract for dredging operations in the anchorage and maneuvering area will be issued sufficiently in advance of completion of the rock removal work to provide for continuity of contract operation in the harbor. Time required for completion of the dredging operations is 31 months.

21. Time required for completion of the entire project is 38 months. Fund requirements for the above schedule is as follows:

Allotted to date	$ 285,000
Fiscal Year 1964	2,000,000
Fiscal Year 1965	2,300,000
Fiscal Year 1966	2,300,000
Fiscal Year 1967	1,250,000
Total Funds	$8,135,000

OPERATION AND MAINTENANCE

22. Maintenance of the project is the responsibility of the United States and will consist of periodic dredging to restore project depths within the limits of the authorized Federal project modification. The additional annual maintenance cost is estimated at $4,000 based on an average annual deposition over the dredged area of 1,400 cubic yards.

BENEFITS

23. The benefits expected to accrue from construction of the improvement are the same as those evaluated in the authorizing document. The benefits were evaluated on the basis of present and prospective deep-draft tanker traffic and commerce in the harbor over the life of the project through savings in transportation costs. The benefits anticipated to accrue from the improvement to the various classes of tankers, present and prospective after improvement, are summarized as follows:

Summary of Benefits

	45' Channel and Maneuvering Basin	45' Anchorage	Total
Transportation Savings (60,000 dwt vessels)	$1,464,000		$1,464,000
Elimination of Anchorage Delays (60,000 dwt vessels)		$ 79,700	79,700
Elimination of Tidal Delays (45,000 dwt vessels)	49,800		49,800
Elimination of Anchorage Delays (45,000 dwt vessels)		99,800	99,800
Elimination of Anchorage Delays (35,000 dwt) Crude Oil Commerce		80,200	80,200
Elimination of Tidal Delays (35,000 dwt) Crude Oil Commerce	16,100		16,100
Elimination of Anchorage Delays Anticipated Fore River Traffic		41,100	41,100
Total	$1,529,900	$302,800	$1,830,700

24. Annual charges computed in the authorizing document were based on a 50-year project life at an interest rate of 2-5/8% of the Federal investment. Current annual charges are computed at an interest rate of 2-7/8% over a 50-year project life.

Annual Charges

Investment	$8,163,000
Project life	50 years
Interest rate	2-7/8%
Interest and amortization	309,700
Maintenance	4,000
Total Annual Charges	$ 313,700

25. A comparison of annual benefits of $1,830,700 to the estimated annual charges of $313,700 yields a current benefit-cost ratio of 5.8 to 1.

RECOMMENDATIONS

26. The plan of improvement proposed in this design memorandum provides for an entrance channel 1,000 feet wide and 45 feet deep from deep water in Casco Bay to a line about opposite Fort Gorges, and a maneuvering basin and anchorage 45 feet deep in the existing House Island anchorage area. The plan is the same as that recommended in the authorizing document and authorized by Congress. This project plan will serve adequately the present and prospective needs of the harbor and economically is justified. It is recommended that the authorized project be constructed as described.

Incl - Map (1)